

'COLOSSUS CHESS 2-0'



Commodore 64

'COLOSSUS CHESS 2-0'

A chess playing program, for the CBM 64 micro.

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1.a - General

Colossus is the best computer chess program available on any home computer. It is written using the very latest techniques by a computer chess programmer of seven years experience. It has been tested against a wide range of other chess programs and proven stronger than any of the opposition. It has the widest range of true features available, including some, never before implemented on any home computer chess program. Colossus also has a perfect understanding of all the rules of chess, including underpromotions, the fifty move rule and all draws by repetition.

1.b - Running the program

Put the cassette into the recorder and rewind it to the start. Press the SHIFT and RUN/STOP keys simultaneously and press PLAY on the recorder. The cassette will run until it finds the BASIC startup program (called 'COLOSSUS CHESS'). It will then display 'FOUND COLOSSUS CHESS'. Press the COMMODORE key to allow the computer to load in the program, which takes approximately 8.5 minutes.

The program once loaded will run automatically.

SECTION 2 - DISPLAY

2.a - General

The display uses two screens to provide clear information as to the state of the game, the programs current thoughts and the past move record. The main screen shows a graphics chess board and various messages and questions as required. The second screen shows the past move record, including the player names and chess clocks and also information on the programs thought processes including lookahead, positions examined and best-line with evaluation. The display can be toggled between the two screens by pressing the (SPACE) bar.

2.b - The board

The main screen has a graphics board printout showing the current position. Letters and numbers around the board indicate the algebraic notation used for each square.

2.c - Messages and questions

Various messages and questions are displayed below the board as necessary. These are explained in more detail in later sections.

2.d - The move record

The secondary screen shows the last seven moves made by each side in two columns including move numbers. Above the moves are displayed the colours, player names and elapsed-time chess clocks for each side.

2.d.i - The player names

Above each column is displayed the names of the white and black players. The programs name is displayed as 'Colossus' while its opponents name is displayed as 'Opponent'.

2.d.ii - The clocks

Below the player names are displayed the elapsed-time clocks for white and black. The clocks are in the format 'hh:mm:ss' (hh = hours, mm = minutes, ss = seconds). The clocks show the total time used by each side in the game so far.

2.d.iii - The moves

The moves are displayed in algebraic notation with the from-square followed by the to-square. The separator between the from- and to- squares indicates whether the move is a capture or not ('x' signifies a capture, '-' signifies a non-capture). Castling moves are indicated with the from- and to- squares of the moving kind. En-passant captures have no special indication.

Promotions are indicated after the move by a '/', followed by a letter to indicate the promoted piece ('N' = knight, 'B' = bishop, 'R' = rook, 'Q' = queen). Checks are indicated by a '+' being printed after the move.

2.e - Technical information

The bottom of the secondary screen is used to display detailed information of the programs thought processes. This information can provide a great insight into how a good chess program works, but only takes a fraction of one percent of the programs thinking time to display it.

2.e.i - Lookahead

When the program thinks about its move, it displays the lookahead depth of its search. The depth is printed in 'ply' or 'half-moves'. The program will search most move sequences to at least this depth, with some being searched much deeper.

2.e.ii - Positions examined

The number of positions examined in the tree of move sequences is displayed. This number is updated at every position and in fact takes very little time because of the single-byte/character type of display. The program examines on average about 520 positions per second.

2.e.iii - Best line

The program displays the best line it has found so far in its search. This can provide you with a 'hint' move and an analysis of the game in the next few moves. (Usually the line will contain a 'null' move. This simply means a passive, non-capturing move). Also displayed is the evaluation of the best-line, as two numbers. The first is the material evaluation (in terms of number of pawns up or down), the second the positional evaluation. A positive number means the program is better, a negative number means the opponent is better.

2.e.iv - Current move

To the right of the board is displayed the move the program is currently considering. This can be seen to change as the search progresses.

SECTION 3 - PLAYING A GAME

3.a - New game

When a new game is started, the pieces are setup in their initial positions, the clocks are reset to '00:00:00', the move display is cleared, the white clock is started, and you are given the option of moving first. Pressing 'G' will make the program take the white pieces and move first (for further details see the 'Go' command described later).

3.b - Your move

Whenever it is your turn to move, the program asks 'Your move?' at the bottom of the main screen. You enter moves by the following cursor positioning method (see the later section 'Cursor movement' for further details).

- 1) Move the cursor to the square of the piece you wish to move, and press the (RETURN) key. This causes the from-square to be displayed. If you accidentally enter the wrong from-square it can be cancelled by pressing the (DELETE) key. (The cursor is shown as an inverse line drawn through the current square).
- 2) Move the cursor to the square you wish to move to and again press (RETURN). This causes the 'to-square' to be displayed.

If the move is illegal, the message 'Illegal' is displayed and the move entry cleared. You must then return to step-1 above and try again.
- 3) If the move is a pawn promotion the program then asks 'Promotion piece?'. You must then specify the piece you want to promote to by typing one of the following: 'N'-knight, 'B'-bishop, 'R'-rook, or 'Q'-queen. If you press any other key, the program assumes you promote to a queen.

Note: If you wish to enter a castling move you should move the king two squares either way.

The legal move is now indicated on the board, by flashing the cursor on the from-square, then moving the piece and flashing the cursor on the to-square.

3.c - Colossus move

When the program computes its move it displays the message 'Let me think...' below the board, and displays the current move

under consideration to the right of the board. The technical information on the secondary screen is updated as the search progresses. When the program has finished its search, it prints the selected move in the move-record and indicates it on the board (in the same way as your moves are indicated) Pressing the COMMODORE key, whilst the program is thinking about its move, will cause it to abort its search, display the message 'Escape' and make the best move it has found so far. If the program has found that its move leads to checkmate, it announces the move with the message 'Mate in N' where N is the number of moves till the mate.

3.d - Game over

When a game is completed, the clocks are stopped and the program displays a message, to the right of the board, to indicate the final state of the game. The messages are:-

- 'Drawn' the game has been drawn by 3-fold repetition of position or the 50-move rule.
- 'Checkmate' the side which moved last delivered checkmate.
- 'Stalemate' the side to move is in stalemate.

The program then asks 'What now?' and waits for you to enter one of the program commands.

Type '(CTRL)N' to start a new game (for further details see the 'New-game' command described later).

SECTION 4 - KEYBOARD ENTRIES

4.a - Cursor movement

The cursor is indicated by an inverse line, drawn through the middle of the current square. It can be moved in two ways.

- 1) The four cursor controls, provide single square movement in any direction. If the cursor is moved off the edge of the board, it reappears at the opposite edge.
- 2) The cursor can be moved immediately to any rank, by typing one of the number keys '1' to '8'. It can be moved to any file by typing one of the 'lowercase' letters 'a' to 'h'. (Lowercase letters are entered by pressing the letter key and (SHIFT) together. Alternatively (SHIFT-LOCK) can be engaged if you wish to use this method regularly.) This allows algebraic notation to be used when entering moves e.g. engaging (SHIFT-LOCK) and typing e2(RETURN)e4(RETURN) will enter the common opening move Pe2-e4. Note that if the rank or file of the from- and to- squares is the same, the key sequence can be shortened, i.e. in the above example e2(RETURN)4(RETURN) would also work.

The initial position of the cursor depends on the current side to move.

If white is to move, the cursor starts on square a1.

If black is to move, the cursor starts on square a8.

4.b - Numeric data

Many of the programs commands require numbers to be entered to setup new values of parameters etc. The program employs a simple to use, idiot-proof method for entering numbers. First the current value of the parameter is displayed at the query position. To increment the displayed value use the up-arrow key. If the new value is above the upper limit for that parameter then it is reset to its lower limit. To decrement the displayed value use the down-arrow key. If the new value is below the lower limit for that parameter then it is reset to its upper limit. To enter the new value into the program, press (RETURN). (If you do not wish to change the current value, then just press (RETURN), instead of using the up-arrow or the down-arrow keys.)

4.c - Commands

The following commands can be entered, when it is your turn to move or when the game is over. To enter a command, just type its first letter (shown in capitals in the descriptions below).

Note 1: the clocks are paused while a command is processed.

Note 2: if the selected command requires numeric input and you are viewing the secondary screen, then the program will automatically switch back to the graphics screen.

Alter-position - Type 'A'

Any legal chess position can be setup with this command.

When selected, the program displays the message:-

'Alter position : SSSSS : Command?' (where SSSSS is the side to move) When in 'Alter-position' mode a further subset of commands, allow you to adjust the board thus:-

Get initial data: Type 'G'

If after changing part of the position, you decide you've made a mistake, the initial position can be retrieved with this command.

Move-number: Type 'M'

The program asks 'Move number?', thus allowing you to enter the new move number required. (See section 3.b for more details on how to enter numeric data.)

Side-to-move: Type 'S'

This toggles the side to move between white and black. When pieces are added to the board, their colour is determined by the current side to move.

Clear, Pawn, Knight, Bishop, Rook, Queen, King: Type 'C', 'P', 'N', 'B', 'R', 'Q', or 'K'. To change a particular square, place the cursor over it and enter one of the above, to determine the new status of that square.

Wipe: Type 'W'

This removes all pieces from the board, thus allowing positions with very few pieces, to be set-up more quickly.

Invisible, New-game, Orientation:

The 'Invisible', 'New-game' and 'Orientation' commands are still available when in 'Alter-position' mode. (See full descriptions later).

Exit: Type 'E'

This allows you to exit from 'Alter-position', when the required position has been achieved.

If the position is illegal for any reason, the message 'Illegal' is displayed and 'Alter-position' will not be exited. You must then correct the error before exiting.

Illegal positions occur with any of the following:-

either side has no king

either side has more than one king

the side not to move is in check

either side has a pawn on the first or eighth rank

either side has more than eight pawns or promoted pieces

Back-step - Type 'B' & For-step - Type 'F'

All the moves in the game are stored in the program's memory. This allows you to step backwards or forwards through the game record, to get to any required position.

This can be used for several reasons:-

e.g. after you accidentally lose a piece, you can recover your error by using Back-step.

e.g. if you wish to try a different line earlier in the game, you can Back-step to the required position and then carry on playing the different line.

Note: In fact the program only has room in memory for about the most recent 120 moves. This should be enough to store most games completely. If however the game goes on for more than 120 moves, the game record is automatically updated to store the most recent 120. You cannot then Back-step right to the beginning of the game.

Colours - Type 'C'

The ink, paper and border colours can be set to any of the sixteen available colours. The only limitation is that the ink and paper colours cannot be the same, because this would cause the display to 'disappear'. If you try to enter conflicting colours the message 'Illegal' will be displayed and you must re-enter another colour. Note also that you should use a lighter colour for the ink

than the paper or the piece 'colours' will appear inverted i.e. the 'white' pieces will appear darker than the 'black' pieces.

The default colours are: ink = 3(cyan), paper = 0(black), border = 14(light blue).

Elapsed-time clocks - Type 'E'

The elapsed time clocks for both sides can be set from 00:00:00 to 99:59:59. First the program asks for the new value for the white clock and then the new value for the black clock. This can be used to set up reasonable values for the elapsed time clocks, if you change the playing speed in mid-game. The program makes extensive use of the elapsed time clocks to determine how quickly it should play e.g. if you increase the elapsed time on the program's clock, it will then play quicker to keep within the average time it is currently set to.

Go - Type 'G'

This forces the program to move for the current side to move. This can be used repeatedly to make the program play several moves against itself or to force the program to resume play, for the side to move, after the 'Supervisor' command has been entered (see later). It also allows you to switch sides with the program in mid-game.

This command makes the program play white, after a new game has been started.

This command is ignored if the game is over.

Invisible - Type 'I'

This allows you (if you feel confident enough) to play the equivalent of a game of 'blindfold' chess, as sometimes done by strong chess players. The pieces displayed on the board are made invisible. The moves are still indicated on the board and displayed in the move record. Using this command again will make the pieces visible once more.

When 'Invisible' is selected, the word 'Invisible' appears at the top right of the board, to avoid confusion.

Legal moves - Type 'L'

All the legal moves by any piece of the side to move can be shown. First position the cursor on the subject piece and type 'L'. The legal moves will be shown in sequence by flashing the cursor on the target squares. The cursor is then returned to the subject square. If no legal moves exist the cursor will not move. This can be used as a tutorial aid for learners.

Mode - Type 'M'

The program has six modes of play, to allow different speed and style games to be selected. The more time you give the program to think about its move, the better it will play.

The program asks 'Mode?', to allow you to select one of the following:-

1) Tournament mode

Full tournament parameters can be setup.

First, the program asks for the move number of the first time control.

Second, the program asks for the number of moves to secondary time controls.

Third, the program asks for the time of the first time control.

Fourth, the program asks for the time to the secondary time controls.

The program is not strict about your time control and will not claim a win 'on time', if you exceed any time control. The program will usually never exceed its own time control.

2) Average mode

This is really an easy usage version of Tournament mode. Instead of entering all four parameters needed for tournament mode, the program simply asks you 'Move time'. The program will then control its search to use on average the time you enter. (Entering 0 seconds for the average move time, selects the programs fastest level). This effectively provides thousands of 'levels' of play.

Note: in fact, this mode sets up tournament parameters of 60 moves to each time control, with 60 times the average move-time being allocated for each control.

Note: this is the initial mode, with an average of 10 seconds per move.

3) All-the-moves mode

In chess clubs, most games are played with chess clocks, with each player having say five minutes to complete the game or 'lose on time'. This mode allows you to set the complete game-time and the program will try to play all the moves of the game within the specified time. If either player exceeds the game time, the game will be terminated with the message 'Time up'.

4) Equality mode

In this mode, the program will attempt to keep its elapsed time clock closely matched to your elapsed time clock,

effectively playing at a similar speed as you are playing. If you make several quick moves, the program will also probably have to play quickly to keep up with the 'pace' you are setting. If however, you think for a long time over some moves, the program will also be able to think longer over its moves. In practice, the programs clock will usually trail yours by a few minutes.

5) Infinite mode

This mode can be used to solve chess puzzles of the form 'find the best move in this position'. It searches all combinations of all moves to ensure that it does not miss a sacrifice. It also continues searching, further and further ahead, until you tell it to stop, or it finds a mate, or it has searched 14 ply ahead (the programs maximum lookahead). This is very useful for postal chess games where you can just leave the program running overnight to find the best move. When the program starts searching for the move, the clocks are set to 00:00:00, so that the time taken on the move can be recorded. Of course, the program may find the same move in much less time using its normal playing mode.

6) Problem mode

This mode is used to solve chess mating problems.

When selected the program asks 'Problem Type?'. The program can solve two types of problems:- (1) Normal mates - of the form 'White to move and mate black in X moves' and (2) Self mates - of the form 'White to move and selfmate himself in X moves. Of course, Colossus can find mates for black just as easily. Colossus is the first home computer chess program ever to be able to solve selfmates!

The program then asks 'Mate in?', whereupon you must enter the number of moves till the intended mate. Colossus can solve mates up to seven moves ahead. This is more than any previously available chess program. When the program starts searching for the mate, the clocks are set to 00:00:00, so that the time to find the mate can be recorded. If the program finds a mating move, it prints the mating line below the move record, stops the clocks, and asks 'Continue?'. If you are satisfied with the discovered move, then pressing 'N' will cause the program to make this move immediately. If however you wish the program to continue searching for any alternative mate, press 'Y' and the program will restart the clocks and continue searching for another mate. This

process is repeated until no more mating moves are found, in which case the program will then make the last mating move found, on the board. If the program does not find any mate, the message 'No mate' is displayed and the program automatically enters 'Alter-position' to allow you to select another position or correct the current one.

New-game - Type (CTRL)'N'

A new game can be started with this command. Because of the destructive nature of this command it must be entered with the (CTRL) key also pressed. This stops any accidental keypress destroying the current game.

If you have not used 'Alter-position' since the last 'New-game', then the game record is left intact, until the first move of the new game is entered. This allows you to replay through the whole of the last game, by using repeated 'For-steps'.

Orientation - Type 'O'

The orientation of the board printout can be reversed, so that you can play the black pieces up the board. The algebraic notation around the board is also reversed. This is most useful when you wish to play black against the program.

Play-self - Type 'P'

This makes the program play a game against itself, by moving for both sides. When a game is completed, the program pauses for a few seconds, to allow you to study the final position, and then starts a new game automatically. This command is ignored if the program is in problem mode or the game is over. Pressing the COMMODORE key, whilst the program is thinking about its move (but not while it is indicating its move on the board) or after the game is over, will stop the program playing against itself and allow you to resume play for the current side to move.

When playing itself, both player names are displayed as 'Colossus'.

Replay - Type 'R'

The whole game can be replayed from the start to the current position to demonstrate the game-so-far to a spectator. The program pauses between moves to allow you to follow the game. The pause time can be set from 1 to 20 seconds. You can interrupt the replay by pressing the COMMODORE key during one of the pauses. When an action replay is in progress, the message '**Replaying*' is displayed below the board.

Supervisor - Type '5'

This stops the program making any moves, and allows you to play moves for both sides. This allows you to setup a required position by playing through a sequence of moves, or to play a friend using the programs board display. All moves entered are still checked for legality. When supervising, both player names are displayed as 'Opponent'.

Tape - Type 'T'

This allows you to save/load move-records and positions to/from the cassette. The program asks 'Load or Save?'. Type 'L' if you wish to load a previously saved record, or 'S' if you wish to save the current record. If any error occurs during loading the current move-record will be lost. Any errors are reported in the form 'Tape error N' where N is one of the error numbers shown on page 306 of the Programmer's Reference Guide. The (STOP) key can be used to abort a save/load early.

Volume - Type 'V'

The volume of the programs 'beeps' can be adjusted from 0(silent) to 15(loudest). This allows you to change volume without having to go to the television.

SECTION 5 - PROGRAM INFORMATION

5.a - Statistics

Author: Mr. M.P. Bryant

Publisher: CDS Microsystems

Language: 6502 assembly

Code size: 26K

Data size: 5K

Positions examined per second: 520 (average)

Estimated Rating: 1750+ ELO

5.b - Openings book

Colossus has an openings 'book' of about 3000 positions, which it uses to play the first few moves of the game quickly and accurately. Lines vary from 2 ply to 17 ply deep. When there is a choice of book moves at any position, Colossus will choose between them at random, with a slight bias towards the moves which Colossus itself considers best.

5.c - Results

Colossus 2.0 has been tested against numerous other chess programs and has beaten them all. In the tests, sixteen games were played, on various levels, with an equal number of whites and blacks for each program. One point was awarded for a win, half a point for a draw, no points for a loss. The results of these tests were as follows:-

Colossus 2.0 beat the following programs by:-

| | | | |
|-------------------|-------------------|----------|--------|
| White-Knight Mk11 | BBC Publications | BBC | 11 - 5 |
| Superchess 3.0 | CP - Software | Spectrum | 12 - 4 |
| Grandmaster | Audiogenic | CBM 64 | 12 - 4 |
| Cyrus IS Chess | Sinclair | Spectrum | 13 - 3 |
| Spectrum Chess II | Artic | Spectrum | 14 - 2 |
| Chess | Acornsoft | BBC | 16 - 0 |
| Chess | Bug-Byte | BBC | 16 - 0 |
| Chess | Computer Concepts | BBC | 16 - 0 |
| Chess | Program Power | BBC | 16 - 0 |
| Chess | Atari | Atari | 16 - 0 |
| Chess | Oric | Oric | 16 - 0 |
| Chess | Psion | Spectrum | 16 - 0 |
| Master Chess | Mikro-Gen | Spectrum | 16 - 0 |
| Sargon 2.0 | Hayden | Apple II | 16 - 0 |
| ZX Chess | Artic | ZX81 | 16 - 0 |

NOTE: White-Knight was the 1983 Home Computer European Champion!!!

